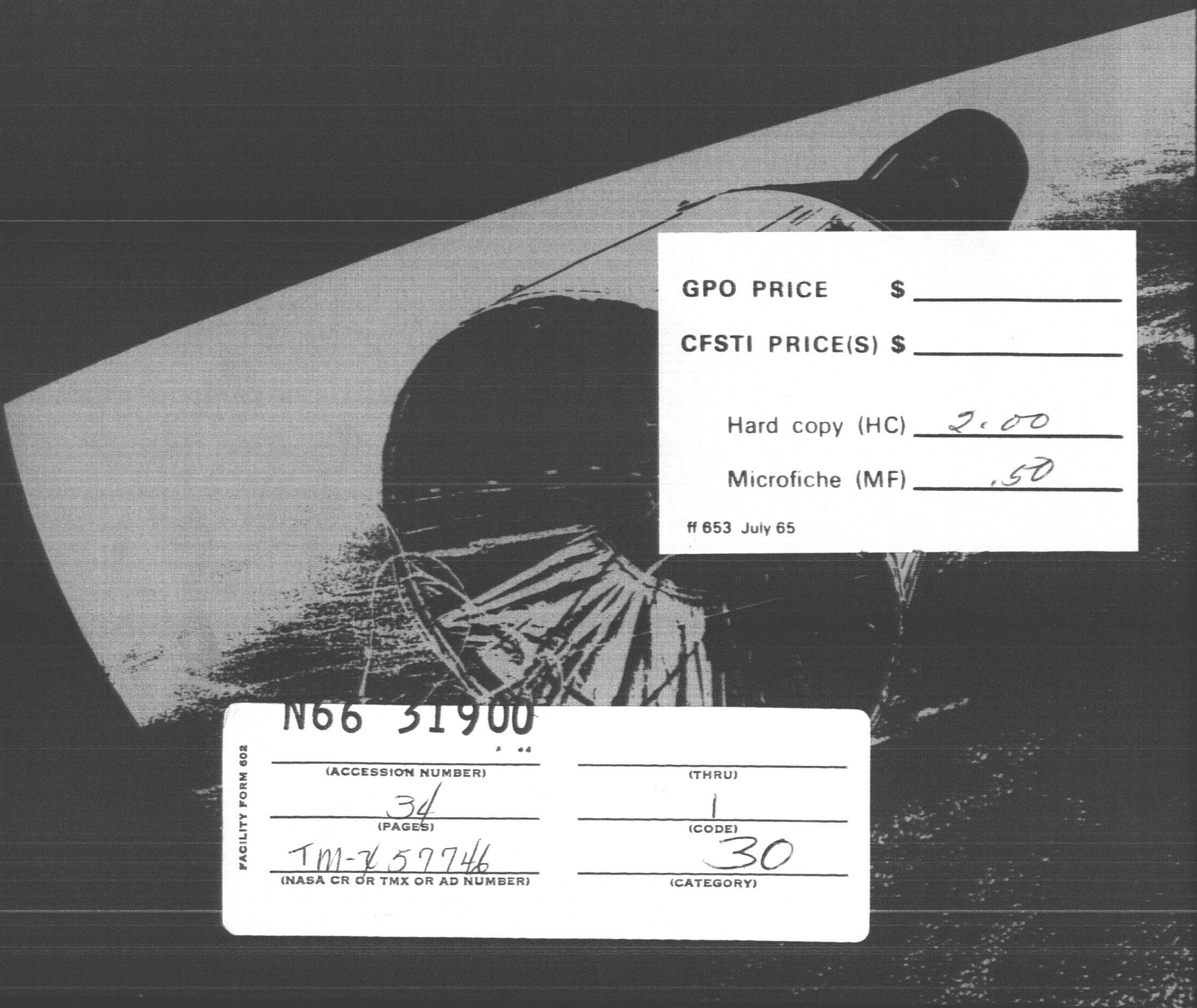
MANNED SPACE FLIGHT 1966



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National Aeronautics and Space Administration

This pamphlet is based on material presented by Dr. George E. Mueller to The Business Council in Washington, D. C., on February 17, 1966. Dr. Mueller, Associate Administrator for Manned Space Flight, has been a member of the Washington staff of NASA since September 1, 1963. He is responsible for the Gemini and Apollo programs, the studies of advanced manned missions and the institutional direction of field centers in Houston, Texas, Huntsville, Alabama and Cape Kennedy, Florida. Before joining NASA he was professor of electrical engineering at Ohio State University and then vice president of Space Technology Laboratories, Redondo Beach, California.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D. C.

MANNED SPACE FLIGHT 1966

The United States is carrying on a great national endeavor to achieve pre-eminence in space and to demonstrate that leadership before the end of this decade by landing men on the moon and returning them safely to earth. To achieve this goal, the United States will have developed a broad base of equipment, trained manpower and industrial support that is capable of carrying out space missions other than the manned lunar flight.

This pamphlet will report on the program by covering five topics:

- The status today,
- The investment,
- The returns to date,
- What else can be done and why that might be desirable, and
- Decisions that need to be made now.

COMPETITION

The competition is keen. On February 3, 1966, the Soviets reminded the world of their intentions in space by landing a spacecraft softly on the moon. On March 1, 1966, a Soviet spacecraft struck the planet Venus. The Soviet investment in space is of the same order as that of the United States. The pace of the Soviet program almost doubled in 1965, including the launching of a new booster, used to orbit the Proton spacecraft, about a ton heavier than anything placed in orbit by the United States.

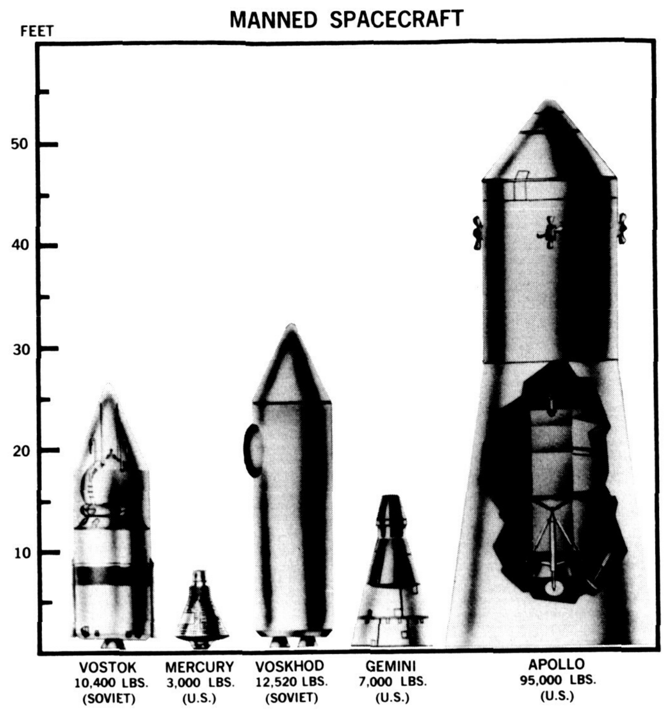
The industrial, scientific and engineering communities in Europe have become increasingly concerned about the technical leadership they believe is accruing to the United States and the Soviet Union as the result of the space programs. France has launched two satellites from its Sahara Desert base since November, 1965. Japan has disclosed plans to launch a satellite in the near future.

Now, where are we today? The Space Age began on October 3, 1957. From an area east of the Aral Sea in Soviet Kazakhstan, the first artificial satellite of the earth was placed in orbit. The Soviets called it Sputnik. It weighed almost 200 pounds.

Three months later, the United States placed its first satellite in orbit. Ours weighed thirty pounds. Today, we are able to boost payloads weighing 1,000 times the first American satellite, Explorer I. Next year, we will be able to boost payloads 10,000 times the weight of Explorer I. Thus the pace of our program is increasing.

Up to now, four different craft have been used in the Soviet and American programs to place man in

The moon as seen by Ranger IX from 258 miles, March, 1965 space. The first was the one-seat Soviet Vostok, which carried men five times and a woman once. Then there was our one-man Mercury, which placed men in orbit four times. The next Soviet spacecraft was the Voskhod, flown twice—the first time with three men and the second with two. Then there was our two-man Gemini, which has been flown six times with men. The latest spacecraft, which has not yet flown men, is our three-man Apollo. The Apollo consists of three separate units—the command module in which the astronauts ride on takeoff, the lunar module, which lands two men on the moon and lifts them off again, and the service module, which supplies propulsion that finally returns the crew to earth.



STATUS

This last year has been particularly successful for the United States, both in manned and unmanned flight. Last March, for instance, we saw pictures live from the moon just before the Ranger spacecraft impacted on the lunar surface.

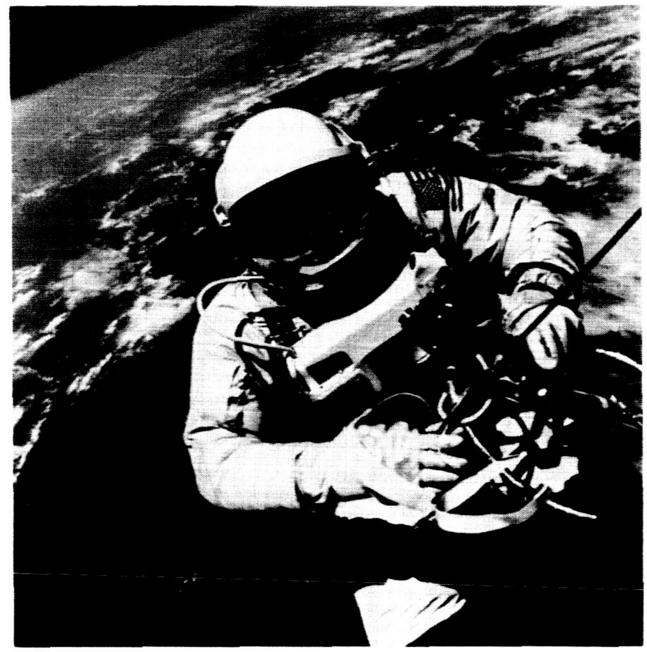
In July, we received the first pictures taken from close to Mars. We saw craters, very much like those we saw on the moon. We learned that the Martian atmosphere is less dense than had been expected.

Altogether, during 1965, the National Aeronautics and Space Administration launched spacecraft on 28 missions. Of these 23 were successful for a record of 82 percent success. This publication will concentrate the bulk of its attention on the manned space flight program.

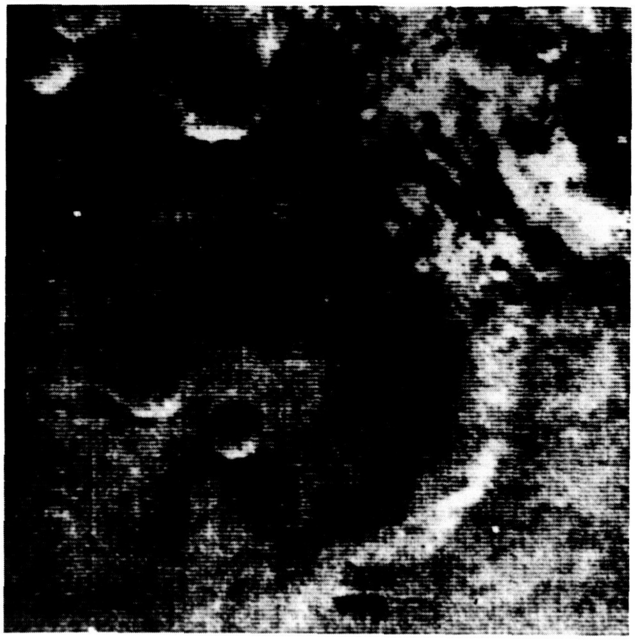
During 1965, the Gemini spacecraft was flown six times, once unmanned in addition to the five times with men. The missions increased in duration by regular amounts, from a day and a half by Gordon Cooper in the final Mercury flight in 1963 to fourteen days by the end of 1965. Perhaps the most significant result of the Gemini program to date is that in every case, the men returned in excellent health, both physical and mental.

Jim McDivitt and Ed White were up four days in June. Cooper flew again in August, this time with Charles Conrad, for eight days. Frank Borman and James Lovell were in orbit two weeks in December, about twice as long as a flight to the moon and back.

From the medical point of view, the flights showed that well-trained men can live and work in space for extended periods of time, and that the condition of



Astronaut Ed White, June 3, 1965



Mars craters via Mariner IV, July 14, 1965

weightlessness does not appear to cause any serious after effects. The astronauts' heart rates, for example, were measured continuously during flight and after their return. The heart rates tended to slow down slightly the first few days of flight and then stabilized at a new lower level. After return to earth the pilots' heart rates returned to their preflight norm in a day or two. When the duration was extended to four, eight and then fourteen days, the recovery time did not significantly change. So far as our medical people can determine at this time, flights of a month or more in duration are feasible. Altogether, in Gemini last year 1,299 hours in space were logged, ⅔ of a man-year on the job.

A significant event of 1965 was Ed White's twenty-two minute trip outside the spacecraft. White proved that man can do useful work in space. He showed that man is able to move about in space with a hand-held compressed-oxygen maneuvering unit. White was alert and effective throughout the time he was outside, and there was no disorientation.

Finally, rendezvous was achieved. There was trouble in October when the Agena target vehicle failed to reach orbit. Consequently, our plans had to be changed. Within the hour after Lovell and Borman took off on their two-week flight in Gemini 7, people were at work around the clock, setting up another vehicle on the same launch pad.

Gemini 6 lifted off eleven days later with Wally Schirra and Tom Stafford. They carried out a complex series of maneuvers for five hours. Then at an altitude of 185 miles above the Pacific Ocean the two came together. Despite their speeds of 17,000 miles an hour, Schirra was able to guide his spacecraft to within one foot of the other. He was aided by some very fine guidance and control equipment.

On March 16, 1966, in the Gemini 8 mission, astronauts Neil Armstrong and David Scott achieved actual docking of their spacecraft and an unmanned Agena target vehicle.

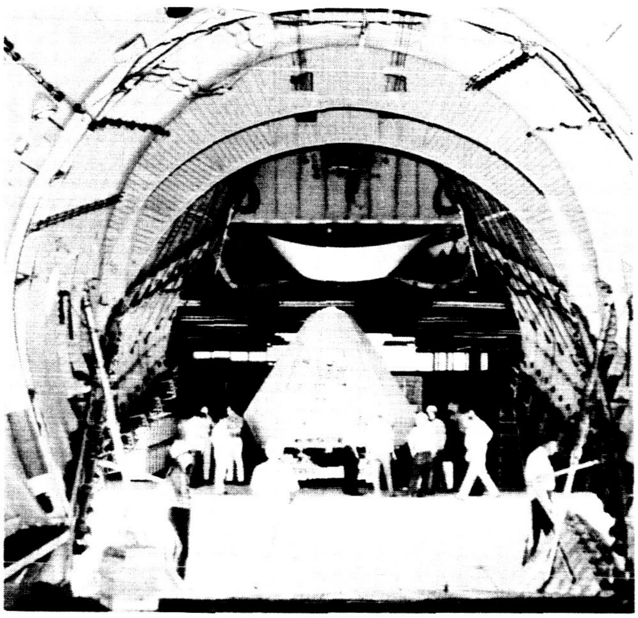
Many people deserve credit for these outstanding accomplishments. A broad-based government-industry team carried out the work. McDonnell of St. Louis built the spacecraft. Other flight hardware was provided by the Air Force and its industrial partner, Martin of Baltimore, as well as many other concerns throughout the country. The Navy recovered all of the spacecraft from the ocean after they came down. The NASA and Air Force people at Houston and Cape Kennedy are responsible for management and operations. The astronauts were magnificent.

Another aspect of Gemini is worth noting. A year ago, the program was behind schedule and we were concerned about the possibility of cost overruns. Through management actions and a new contract in which the profit of the contractors engaged in the Gemini program is tied to their total performance, schedules have been accelerated and costs are under control. I think the operation of these contracts has constituted one of the finest examples of the proper working of the free enterprise system.

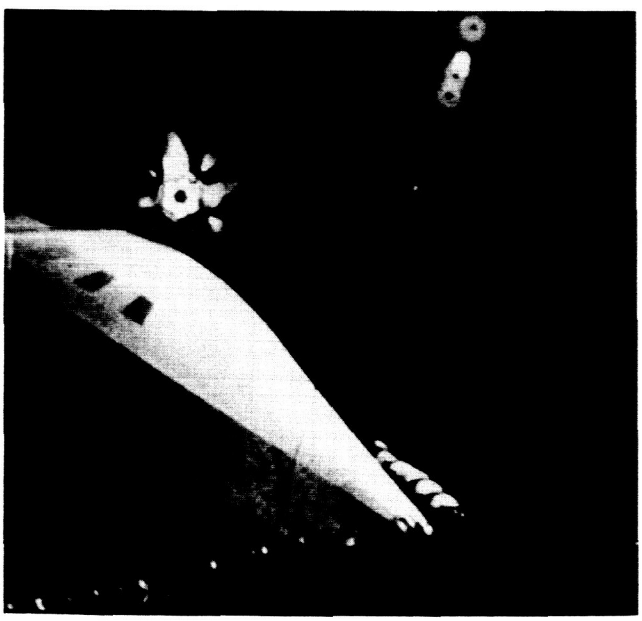
We have also made progress in the Apollo program, which is the largest research and development program this country has ever undertaken. Apollo requires us to develop two major launch vehicles and a three-part spacecraft, to assemble a nationwide government-industry team, to construct a complex of advanced facilities and to carry on a comprehensive testing program, all on a coordinated schedule. In Apollo, the first phase of the Saturn launch vehicle program was completed in 1965. In

Lovell and Borman return after 14 days in space
December 18, 1965

Agena target vehicle as seen from Gemini VIII just prior to docking, March 16, 1966



Apollo spacecraft on special transport plane



Engines of Saturn I second stage, upper left, ignite as, stage moves out from first stage at 40 miles altitude

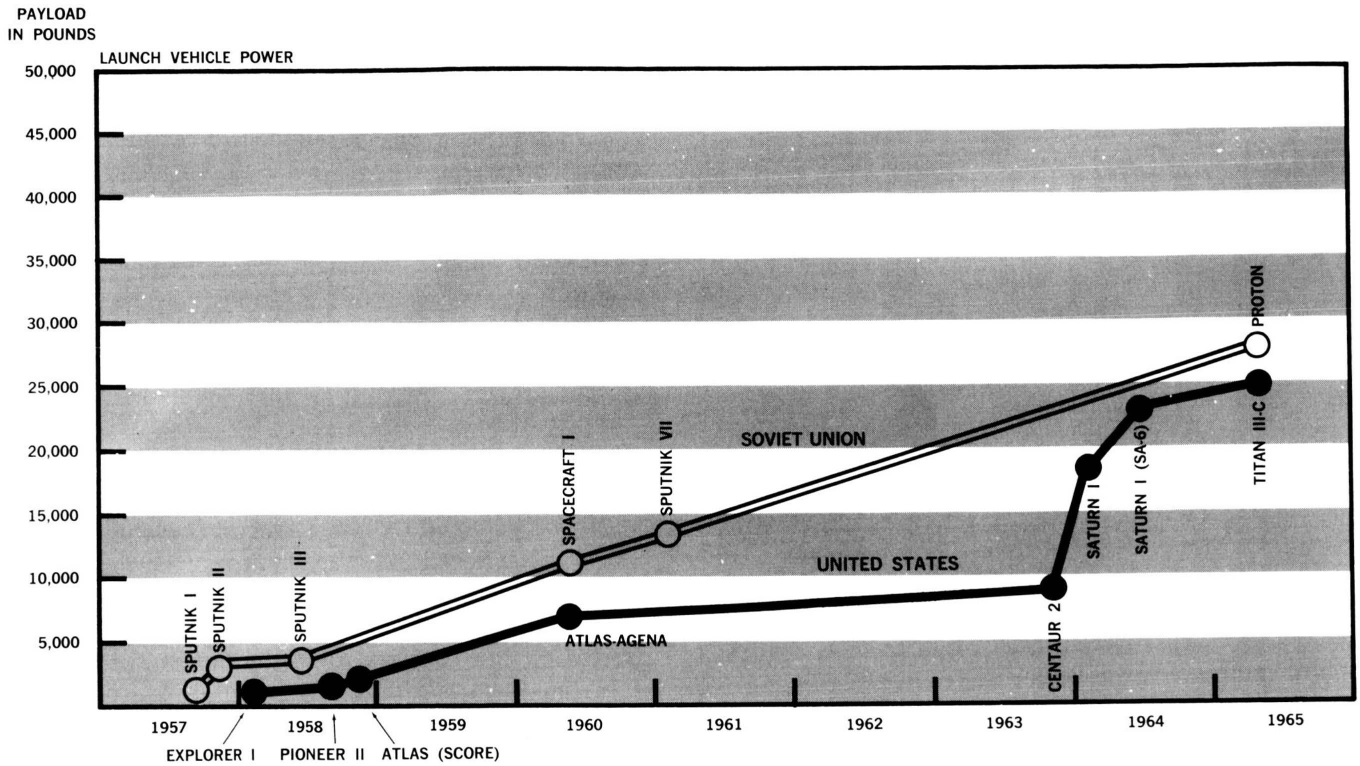
ten flights of the Saturn I, ten were successful. This is an unprecedented record of success in rocket development. Much of the technology required for the later Saturn launch vehicles to be used in the manned Apollo flights was proven out in the Saturn I program. The guidance system was developed. The concept of clustered rocket engines was validated. And the program supplied experience in using liquid hydrogen as rocket fuel. Liquid hydrogen is important because it provides double the fuel economy of earlier fuels—that is, about twice as many miles per gallon. However, before it could be used it was necessary to learn to store it at temperatures more than 400 degrees below zero.

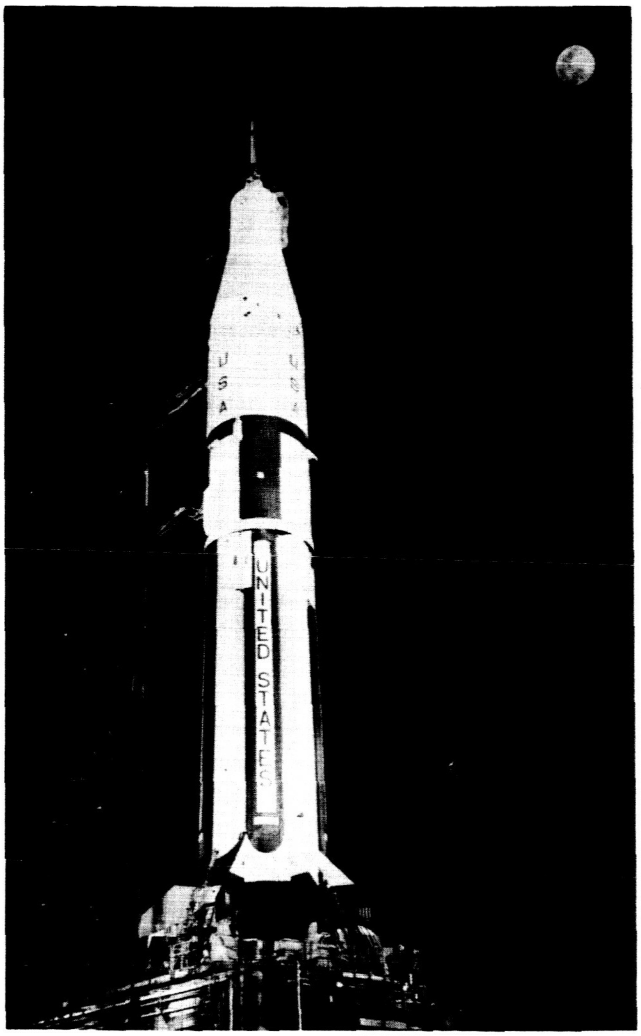
On February 26, 1966, we successfully flight tested the uprated Saturn launch vehicle, the Saturn IB. The flight was unmanned. With this vehicle later this year, we will place some 35,000 pounds in orbit, overtaking the Soviet 1965 achievements.

In the February flight, we introduced a new concept in our flight testing procedures. We call it the "all up" concept. Both stages of the launch vehicle, a complex instrument unit, and the command and service modules of the spacecraft were flown together for the first time. This method enables us to get more test results on a single flight. However, it also represents some increase in risk.

The Apollo program is on schedule. The February flight was *the* major milestone we needed to accomplish in 1966. The next major milestone will be a manned flight with this system, scheduled for 1967. Also in 1967 will be the beginning of the unmanned flights of the Apollo spacecraft and the Saturn V, the launch vehicle for the actual lunar flights. This flight next year will give us the capability mentioned earlier—that of placing in orbit payloads weighing 10,000 times the weight of Explorer I, the first American satellite—almost 300,000 pounds.

Manned flights on the Apollo Saturn V begin in 1968. These will provide the foundation for the


PAYLOAD IN POUNDS
LAUNCH VEHICLE POWER
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
SOVIET UNION
UNITED STATES
SPUTNIK I
SPUTNIK II
SPUTNIK III
SPACECRAFT I
SPUTNIK VII
PROTON
ATLAS-AGENA
CENTAUR 2
SATURN I
SATURN I (SA-6)
TITAN III-C
1957
1958
1959
1960
1961
1962
1963
1964
1965
EXPLORER I
PIONEER II
ATLAS (SCORE)



Apollo-Saturn IB awaits launch

manned lunar landing by the end of this decade.

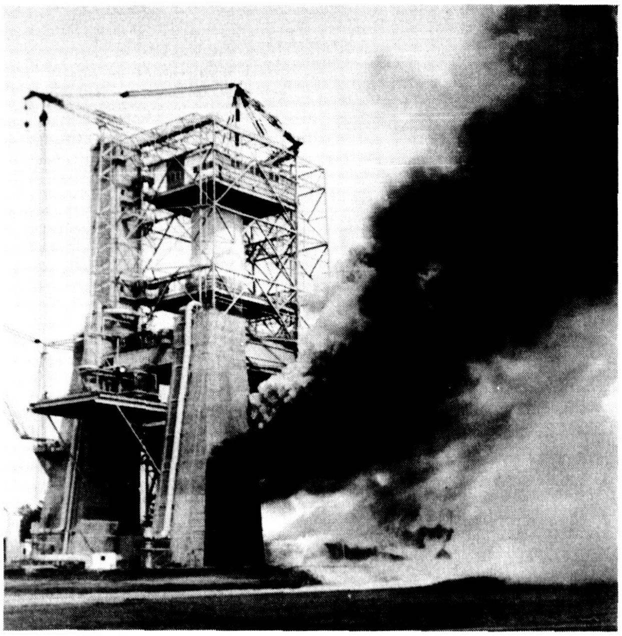
During 1965, excellent progress was made in the development of the Saturn V launch vehicle and the spacecraft to be used on the lunar flights.

All three stages of the Saturn V vehicle were fired in ground tests. The five engines of the first stage generate a total thrust of 7,500,000 pounds, the equivalent horsepower of a line of 1966 automobiles, bumper to bumper, from New York to Los Angeles. The second stage combines 1,000,000 pounds of thrust with the fuel economy of liquid hydrogen. The third stage is the same as the second stage of the Saturn IB. The instrument unit is the same.

The spacecraft, as noted earlier, consists of the command module, the service module and the lunar module. The third stage, the instrument unit, the command module and the service module were tested in flight for the first time in February, 1966. Hardware is being assembled for a 1967 flight test of the lunar module.

The men are also being trained. Two-thirds of our astronauts are occupied with the Gemini program. But ten have already been assigned to Apollo. They are making intensive studies of lunar conditions and the lunar terrain. All are undergoing the necessary scientific training. And the first scientist astronauts are in training.

With respect to the status of the Apollo program, the required Government-industry team is in place and working, the program is on schedule, a schedule set when the program began, and if progress continues, we will accomplish the manned lunar landing and safe return of the astronauts in this decade.



Test firing, Saturn V first stage

INVESTMENT

Next, what have we invested in this program? When I say we, I mean both the government and industry. The total is almost four billion dollars. About two and a half billion dollars of funds appropriated to NASA have been used to acquire facilities and their equipment. We have been able to make use of ground facilities and plant worth $760 million established by the Department of Defense for missile and other programs. Beyond this, American industry has invested some $650 million of its stockholders' funds in new facilities and equipment required to do this job.

For example, at the Marshall Space Flight Center, Huntsville, Alabama, headed by Dr. Wernher von Braun, we manage the work of industry in the development of launch vehicles and the integration of experimental devices in spacecraft.

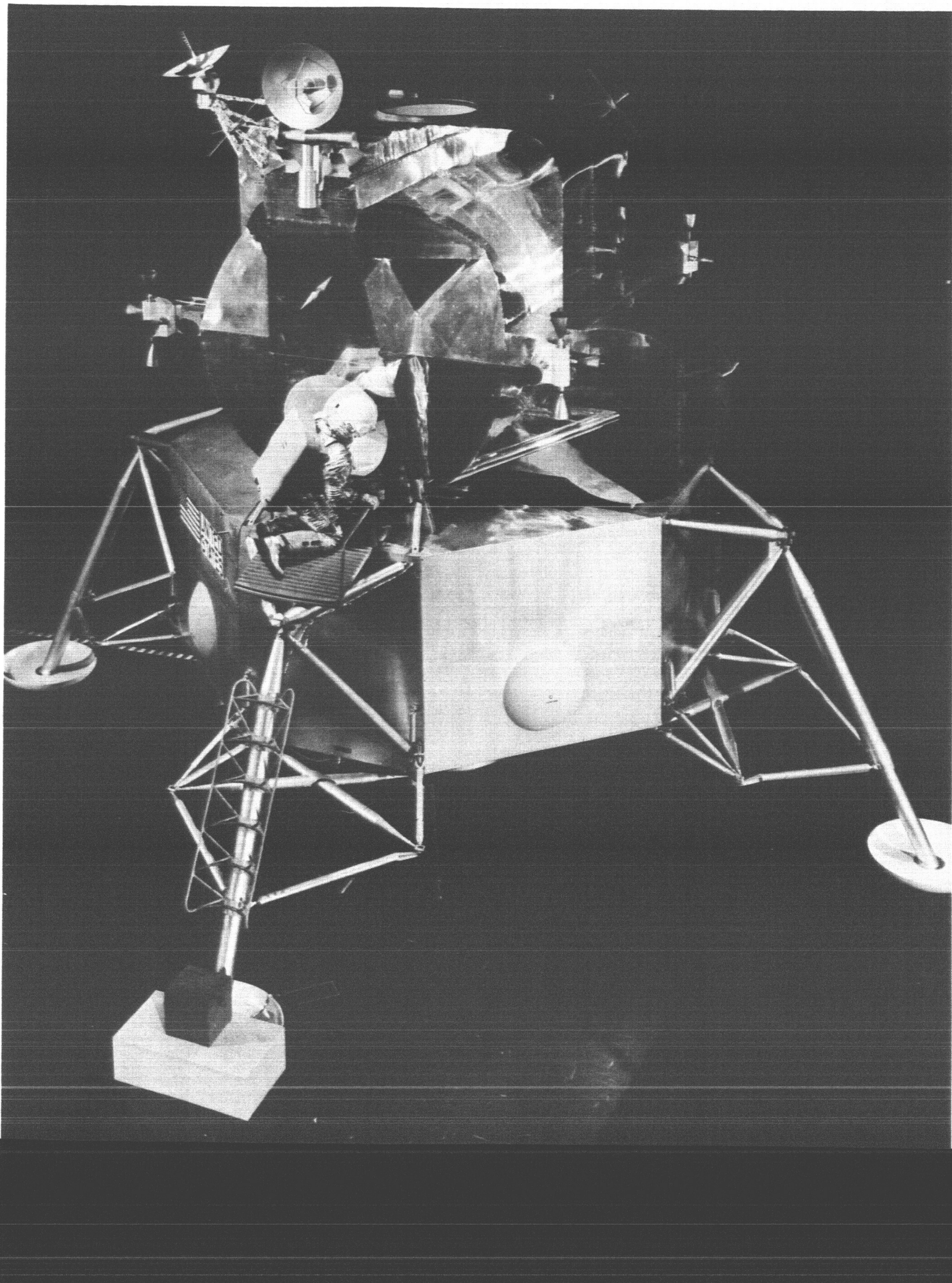
At the Michoud Assembly Facility in New Orleans, we have a very large installation where industrial contractors, Boeing and Chrysler, manufacture Saturn booster first stages.

Forty miles from Michoud, we have converted Mississippi delta swamp land to another large facility, where first and second stages of the Saturn V are test fired prior to acceptance from the manufacturer.

An example of the utilization of industry investment in the potential of space is the Douglas Aircraft plant at Huntington Beach, California, where the final stages of the Saturns are manufactured. Douglas has invested more than $45 million there.

At Houston, Texas, is the Manned Spacecraft Center directed by Dr. Robert R. Gilruth, where a cattle range was converted to a modern installation in less

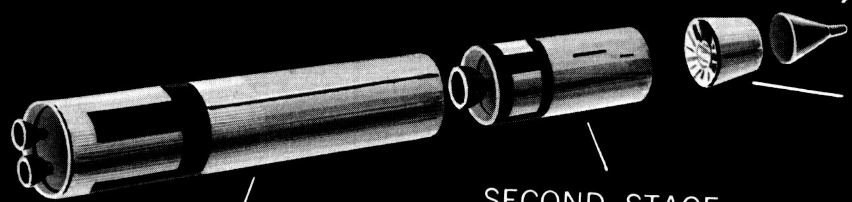
Lunar module prototype

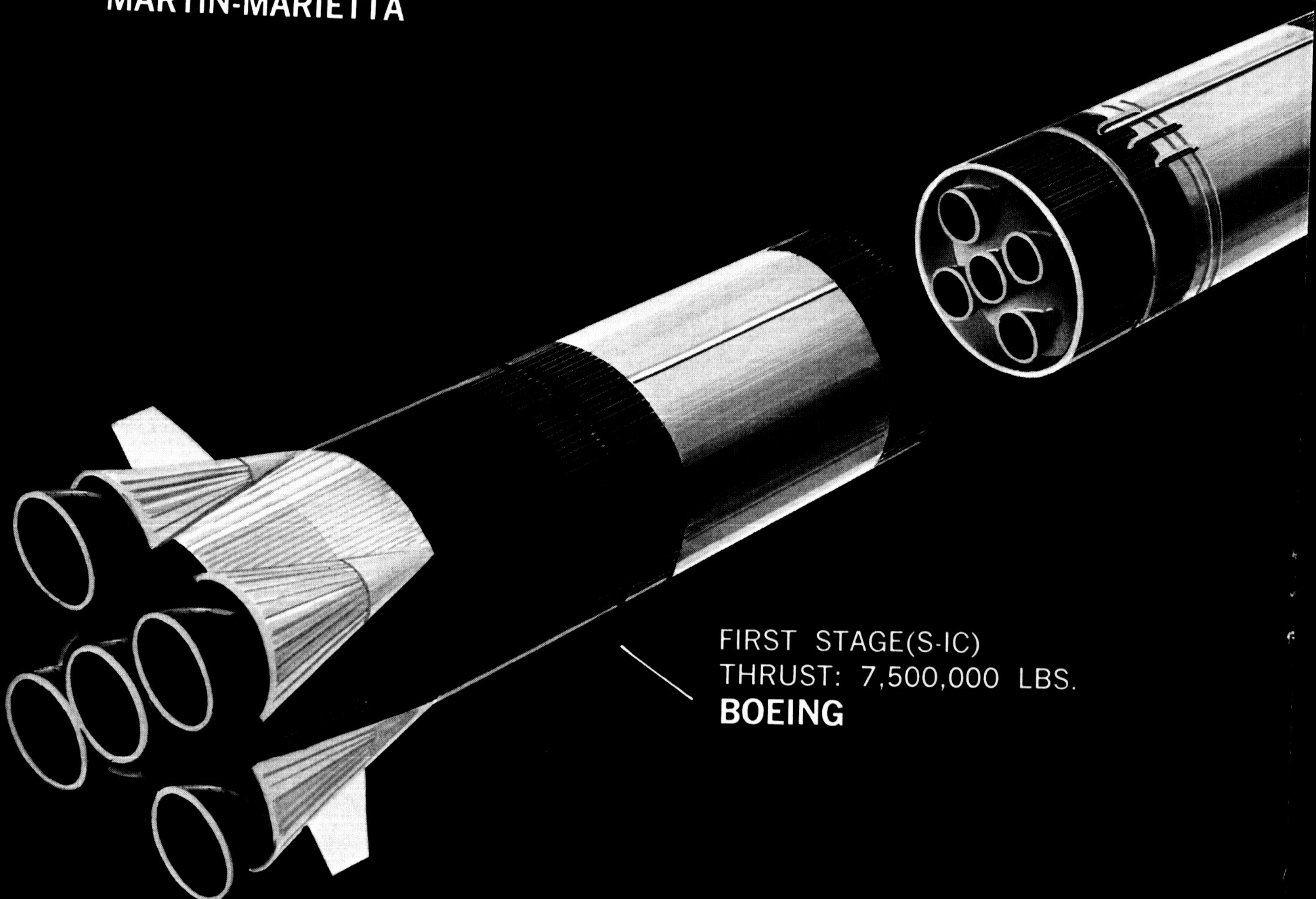


MANNED SPACE

GEMINI

FIRST FLIGHT–APRIL 1964
FIRST MANNED FLIGHT–MARCH 1965

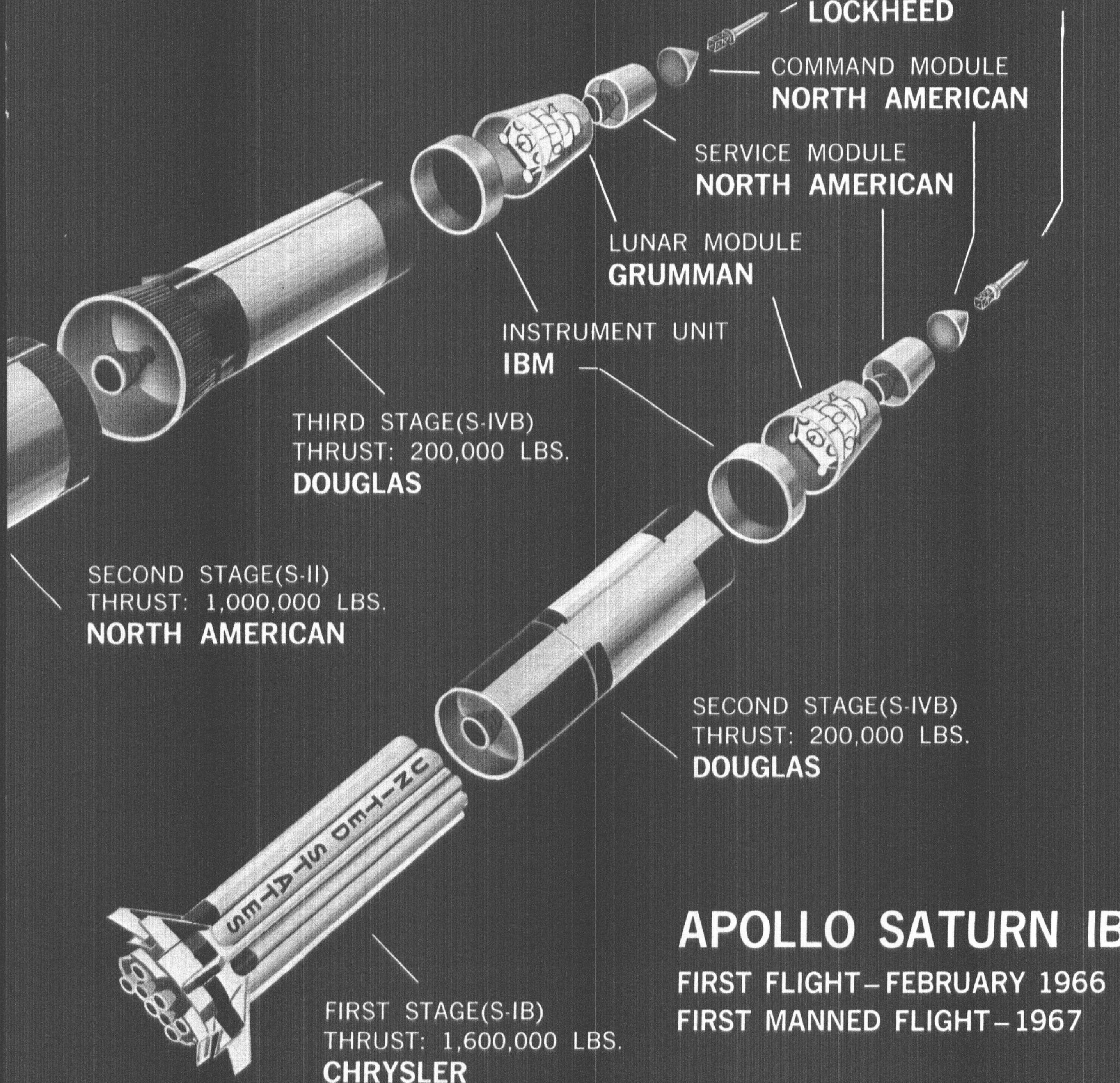




FLIGHT VEHICLES

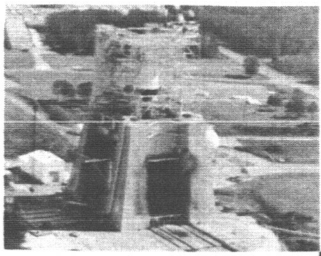
APOLLO SATURN V

FIRST FLIGHT–1967
FIRST MANNED FLIGHT–1968

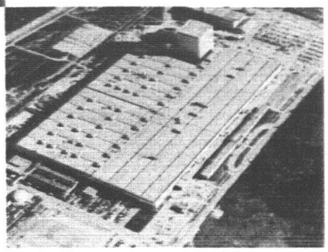


APOLLO SATURN IB

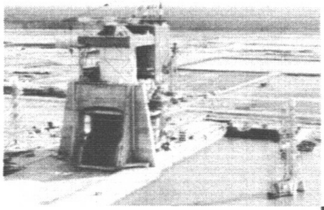
FIRST FLIGHT–FEBRUARY 1966
FIRST MANNED FLIGHT–1967



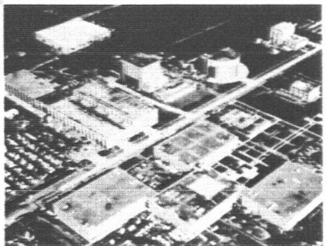
Huntsville, Alabama



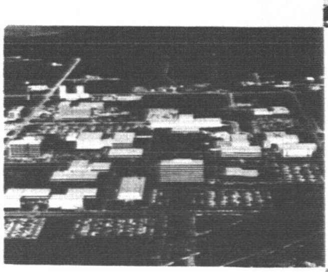
New Orleans



Mississippi



Huntington Beach, California



Houston, Texas

White Sands, New Mexico

than three years. Here we manage the work of industry in the development of spacecraft, we train flight crews, and we support manned space flight operations.

When all of the flight equipment is manufactured and tested at these various facilities, it is shipped by barge, helicopter or special aircraft to the Kennedy Space Center in Florida, headed by Dr. Kurt H. Debus.

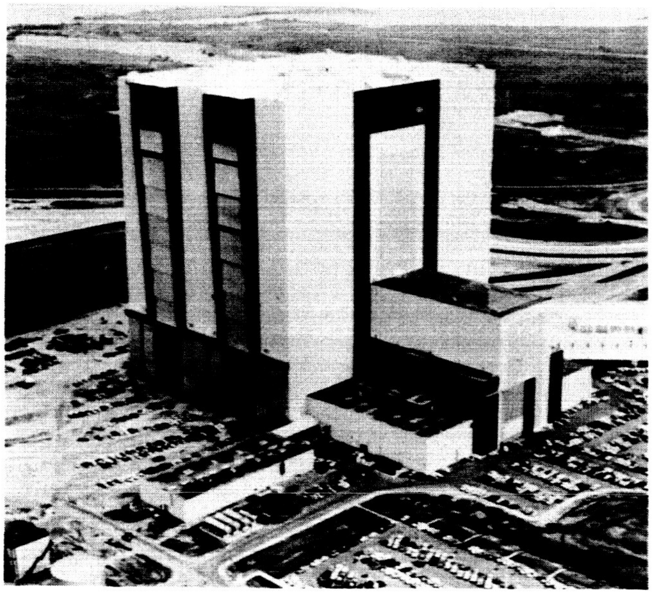
The entire Apollo Saturn V vehicle stands 360 feet high. It is put together in vertical position inside the Vehicle Assembly Building, which in total volume is the largest on earth. The vehicle stands on a platform about twice as large as a baseball diamond. When the vehicle is ready, the doors of the building open and a crawler transporter carries it, still in vertical position, onto a special roadway and travels to the launch pad, more than three miles away. On the trip to the moon, the spacecraft will leave the earth at a speed of seven miles a second. However, on this part of the journey, the speed limit is one mile per hour.

After the craft is launched into space, the mission is controlled from the Mission Control Center at Houston.

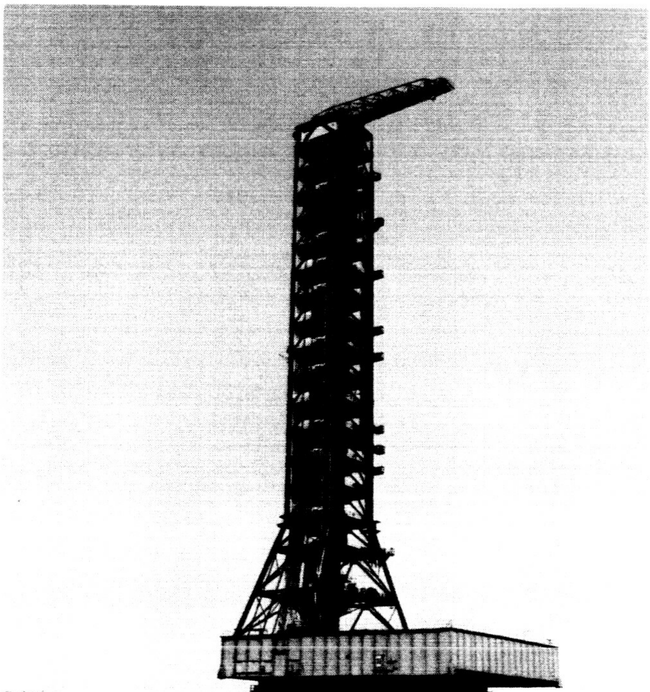
These manned space flight facilities are spread across much of the United States—government installations in Florida, Alabama, Mississippi, Louisiana, Texas and New Mexico, and plants used by industry in California, New York, Wisconsin and Minnesota—and, of course, subcontractors and vendors in all parts of the country.

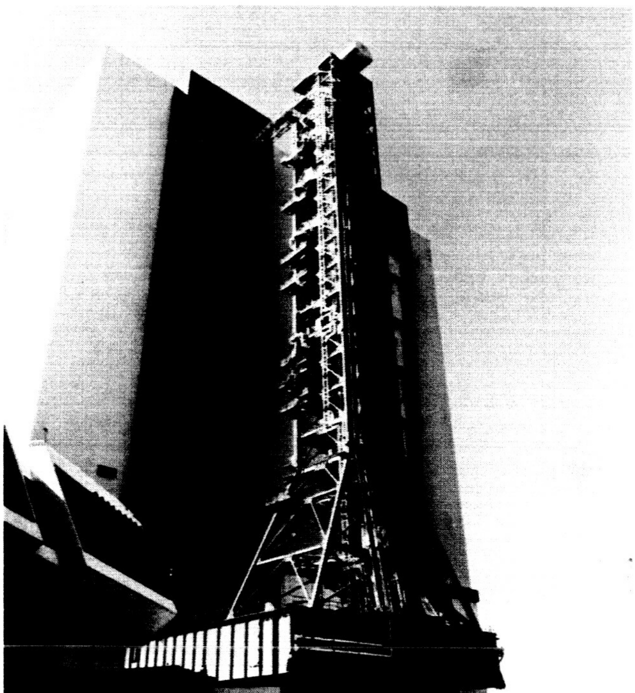
Altogether, the manned space flight program is carried out by a team that consists of our Washington office, three field centers, twelve prime contractors and some 17,000 subcontractors.

Moonport, Complex 39, Kennedy Space Center, Florida

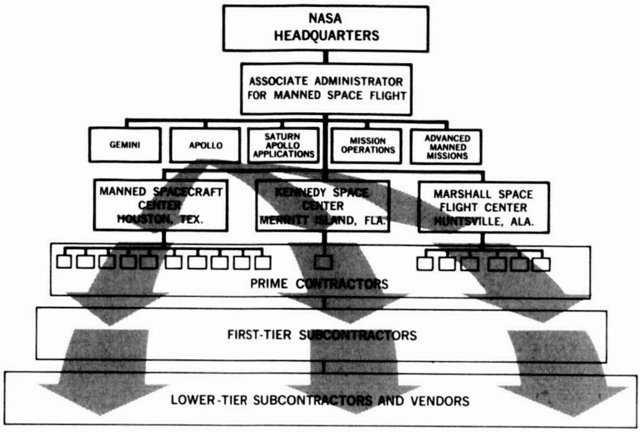

Vehicle Assembly Building exterior

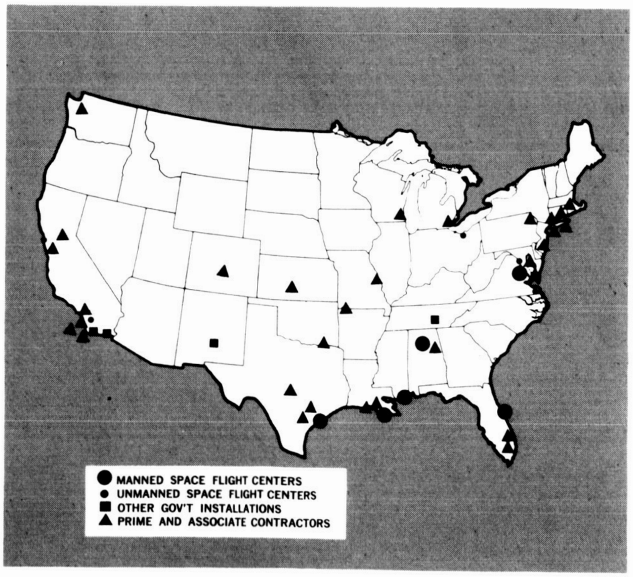

Vehicle Assembly Building interior


Launch Tower moves into launch pad


Launch Tower enters Assembly Building

MANNED SPACE FLIGHT TEAM





Management is carried out by a geographically dispersed program office whose directive structure penetrates directly through the functional organizations of the field centers and the prime contractors, to the subcontractors and vendors.

The techniques of management of large scale research and development employed in this organization may in the long run prove to be the most valuable asset derived from the entire program. One of the fundamentals of this system is the identification of discrete manageable work packages. In addition, we have to assign individuals, both in government and industry, with clear responsibility for carrying out the work on time, within cost and to specification. It is necessary to maintain open channels of communication between these people and those doing related work but located elsewhere. And we must see to it that the status of the program is continually visible to everyone concerned.

In manned space flight we have arrived at our manpower peak of 300,000 people. However, the Civil Service component is only about 5 per cent of the total. Supporting these people is a group of contractors who assist in the operation of our field centers. With the rapid completion of the necessary facilities, construction manpower is phasing out. The bulk of the manpower is engaged in research and development carried out by industrial contractors.

So far as our overall manned space flight manpower is concerned, we have passed our peak in engineering, we are reaching our peak in manufacturing, and we are at our peak in total manpower resources. For the fiscal year which begins July 1, 1966, the proposed budget calls for a level effort.

One of the most striking anomalies of the space program is that we must begin to "go out of business" before we fly our first operational vehicle. Our experience in the program to develop the Saturn IB vehicle illustrates this situation. The decline in manpower employed on this phase of the program has been under way since 1965, especially in the work on the first stage. But the first flight did not take place until February, 1966, and the first manned flight was still a year away. By the time manned flights begin, the employment level will be down to about half the level at the peak.

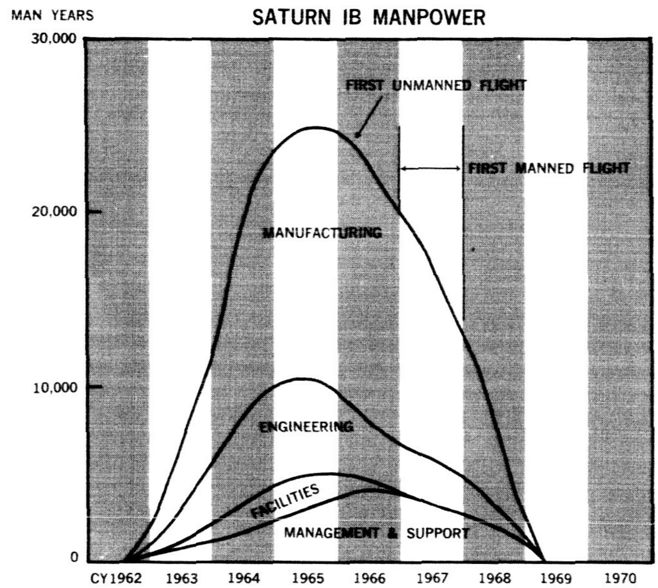
The same anomaly characterizes the overall program. The flights of the Apollo Saturn V will begin next year after the program has begun its decline and the manned flights will not take place until 1968, when this decline will have been under way for some time.

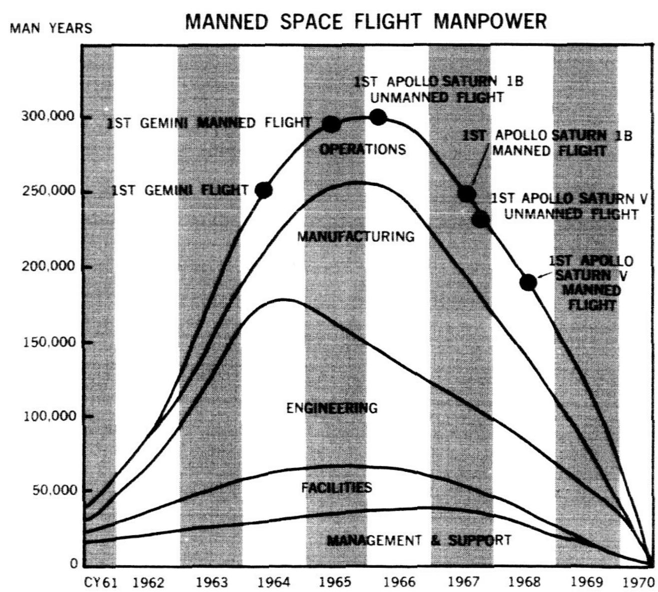
There are three points that should be made regarding the investment in manned space flight.

First, and perhaps most important, there exists an organization consisting of a government management structure of 15,000 people and a prime contractor structure of 135,000 people. These, combined with the subcontractor structure, make a total of 300,000 people trained and established in special facilities for manned space flight work.

Second, the program is under control, working toward clearly established program goals, within total cost estimates established at the program inception.

Third, the time has arrived for a decision as to whether and how this capability might be employed for programs to follow present programs.





RESOURCES

Now what about the resources committed to the space program?

We are most fortunate to live in an economy that is growing rapidly enough to permit the country to do what is being done in Viet Nam and elsewhere. Despite increasing totals of Federal expenditures, the share of the gross national product represented by these expenditures has been relatively stable—close to 15 percent in the last several years.

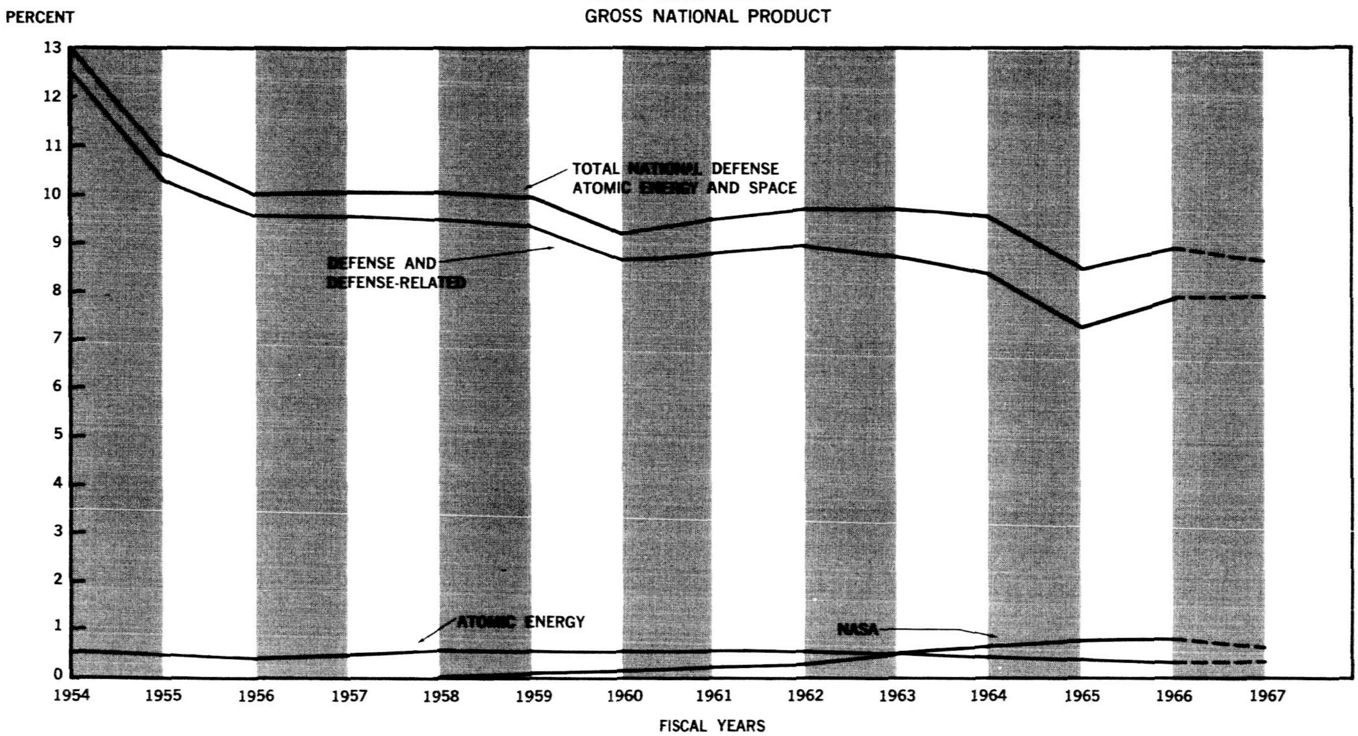
One way to view our national commitment to space activities is to look at that set of related activities encompassed by Federal expenditures for the Department of Defense, the Atomic Energy Commission and NASA.

Twelve years ago, when the gross national product was $362 billion, the expenditures for national defense, atomic energy and the National Advisory Committee for Aeronautics (NASA's predecessor) totaled $47.1 billion. This was 13 percent of the gross national product.

In the current fiscal year, the projected total is $62.26 billion, down to 8.9 percent of the gross national product of $700 billion. In fiscal year 1967, if the gross national product grows as anticipated, the total cost of $66.12 billion for defense, atomic energy and NASA will represent only 8.8 percent. Thus it is clear that the share of our national wealth represented by the costs of these related activities has been declining over the last decade and will continue to decline in the coming fiscal year despite substantial expenditures for Viet Nam.

In view of this, I believe the nation can afford to carry on the space program.

FEDERAL EXPENDITURES
DEFENSE, ATOMIC ENERGY AND SPACE
AS A PERCENTAGE OF THE
GROSS NATIONAL PRODUCT



FEDERAL ADMINISTRATIVE BUDGET EXPENDITURES
NATIONAL DEFENSE, ATOMIC ENERGY AND SPACE
COMPARED WITH GROSS NATIONAL PRODUCT (IN BILLIONS OF DOLLARS)

Fiscal Year	Defense & Defense Related		Atomic Energy		NACA-NASA		Total	Gross National Product	Percentage
1954	45.09	12.5%	1.895	0.52%	0.090	0.02%	47.1	362.1	13.0%
1955	38.84	10.3%	1.857	0.49%	0.074	0.01%	40.8	378.6	10.8%
1956	39.07	9.6%	1.651	0.40%	0.071	0.01%	40.8	409.4	10.0%
1957	41.38	9.6%	1.990	0.46%	0.076	0.01%	43.4	431.3	10.1%
1958	41.77	9.5%	2.268	0.51%	0.089	0.02%	44.3	440.3	10.1%
1959	43.94	9.4%	2.541	0.54%	0.145	0.03%	46.6	469.1	10.0%
1960	43.07	8.7%	2.623	0.52%	0.401	0.08%	46.1	495.2	9.3%
1961	44.78	8.8%	2.713	0.53%	0.744	0.14%	48.2	506.5	9.5%
1962	48.30	9.0%	2.806	0.51%	1.257	0.23%	52.4	542.1	9.7%
1963	50.00	8.7%	2.758	0.48%	2.552	0.44%	55.3	572.4	9.7%
1964	51.42	8.4%	2.765	0.45%	4.171	0.68%	58.4	609.6	9.6%
1965	47.54	7.3%	2.625	0.40%	5.093	0.78%	55.3	648.7	8.5%
*1966	54.27	7.8%	2.390	0.34%	5.600	0.80%	62.26	700.0	8.89%
*1967	58.24	7.8%	2.300	0.30%	5.300	0.70%	65.84	750	8.78%

*Estimates

SOURCES: REPORT OF THE COMMITTEE ON THE ECONOMIC IMPACT OF DEFENSE AND DISARMAMENT, JULY 1965; THE BUDGET OF THE UNITED STATES, 1967

RETURNS

Next, let us examine the returns from this substantial national investment, in addition to the accomplishment of progress goals. Many examples come to mind. The use of computers is prevalent throughout American industry and government. Computers make it possible to produce more at less cost. This frees people from routine, time-consuming work to use to the fullest their ability to think and create.

Microminiaturization has revolutionized electronics.

Some segments of American industry can now produce valves that do not leak and radios that will outlive the automobiles in which they are installed.

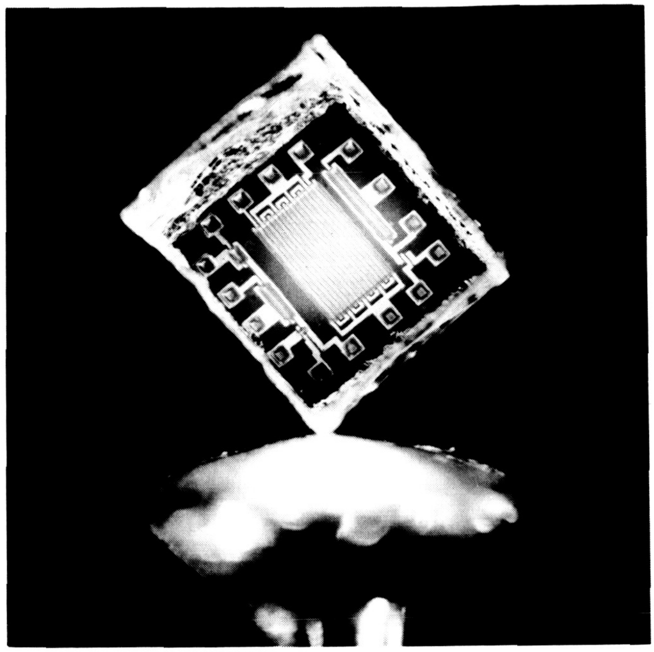
Space communication is a commercial enterprise being carried out by the Comsat Corporation.

Weather observation is being conducted from space on an operational basis.

All-weather navigation service is provided to the fleet by satellites.

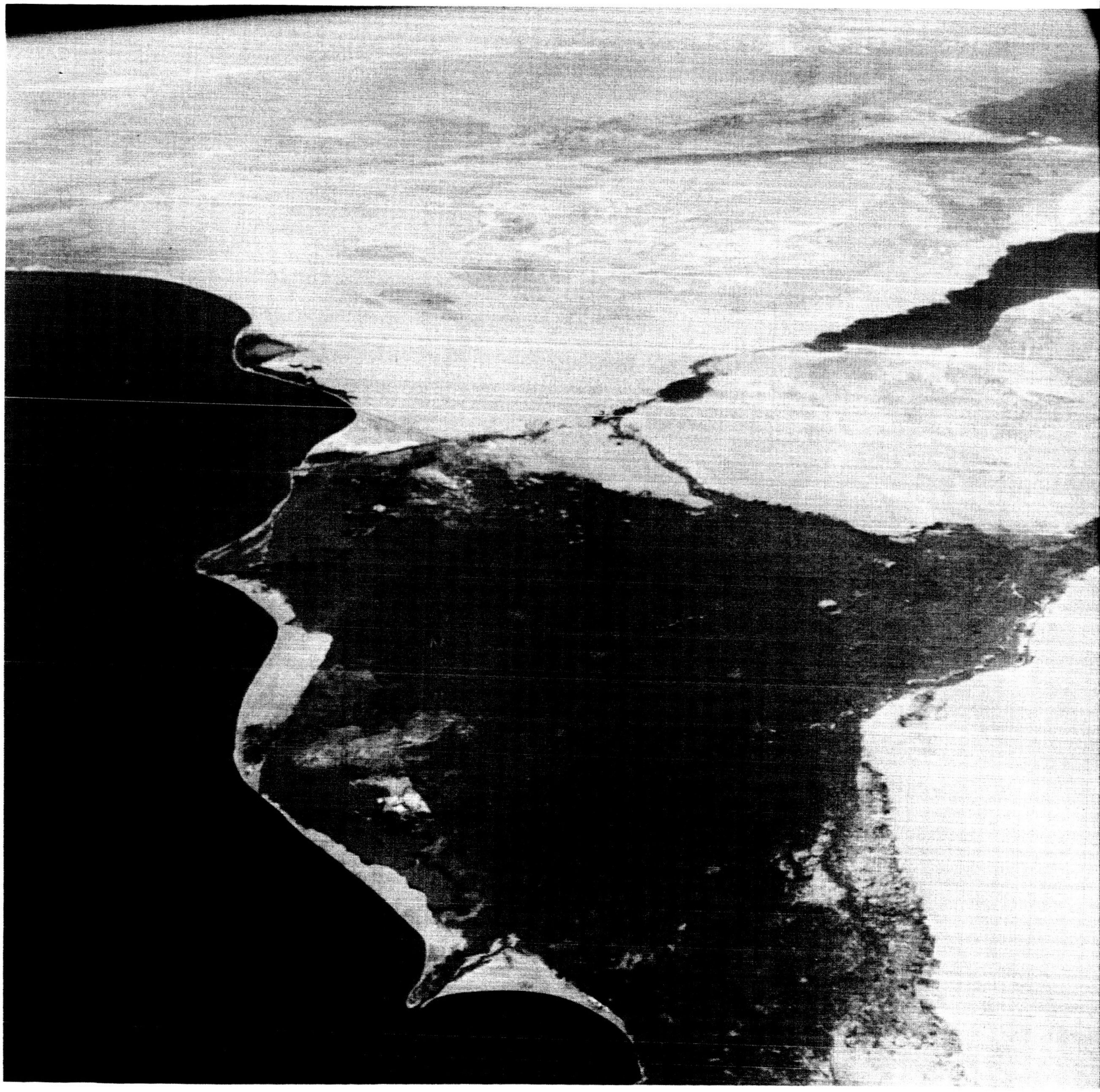
Photographs taken from space have increased man's knowledge of the earth.

And medicine has improved its understanding of the workings of the human body, particularly the well human body.

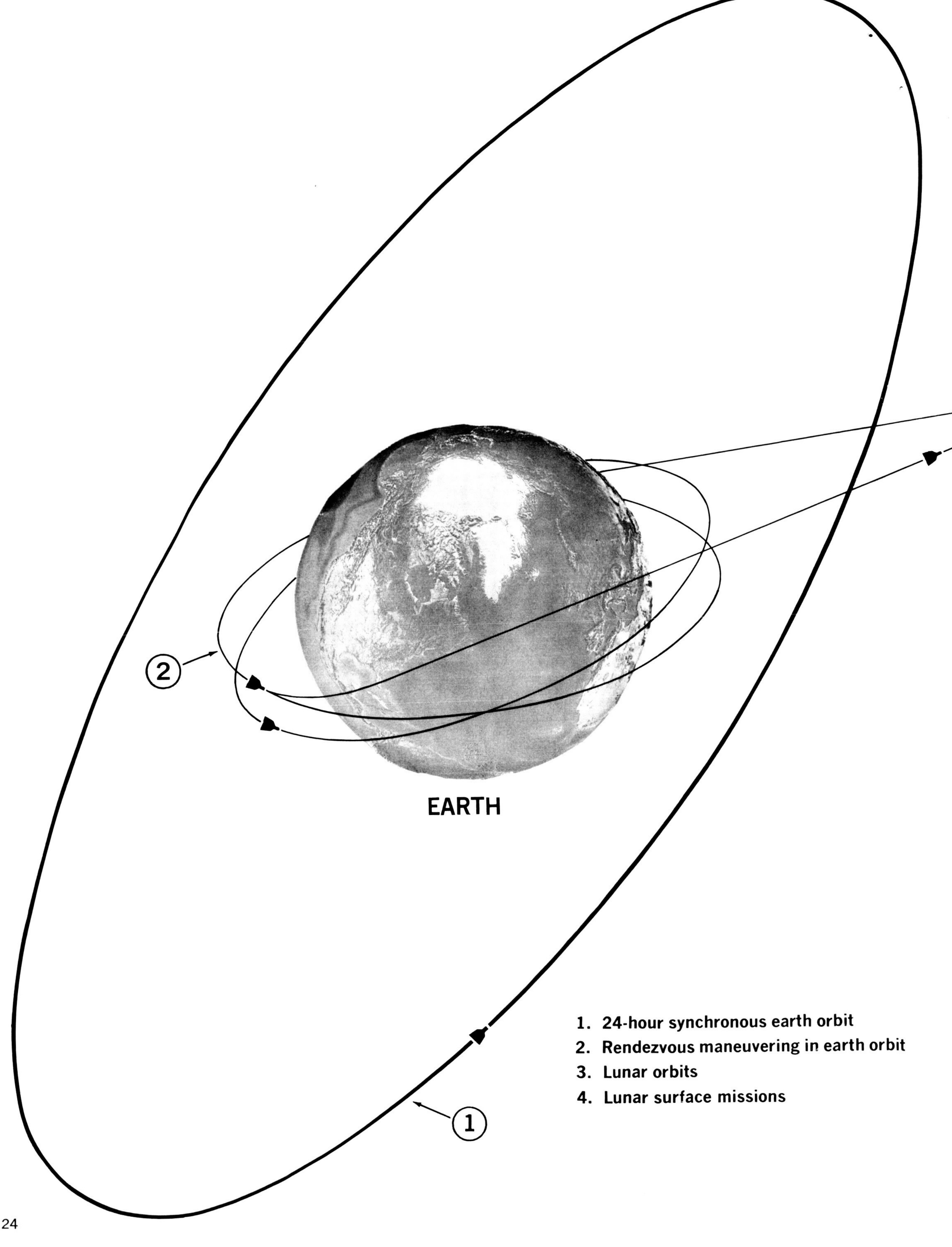


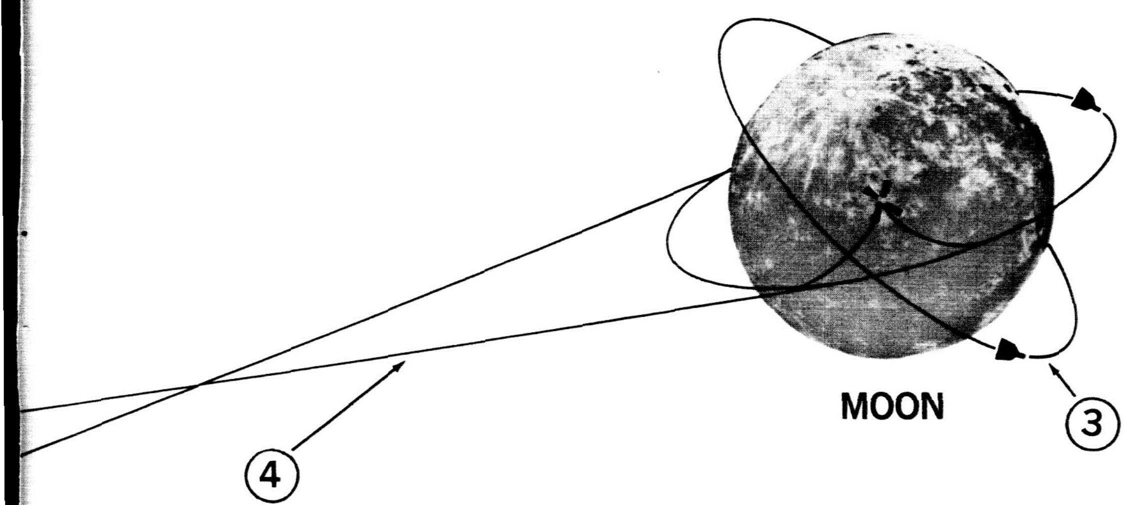
Transistor radio circuit on the head of a pin

1964 Olympic Games in Japan, seen in the U. S. with aid of satellite



Nile delta photographed from Gemini IV


EARTH
2
1
1. 24-hour synchronous earth orbit
2. Rendezvous maneuvering in earth orbit
3. Lunar orbits
4. Lunar surface missions



OPTIONS

But let us return to the manned space flight program. What comes next? With the accomplishment of the Apollo program in this decade, we expect to begin the exploration of the moon.

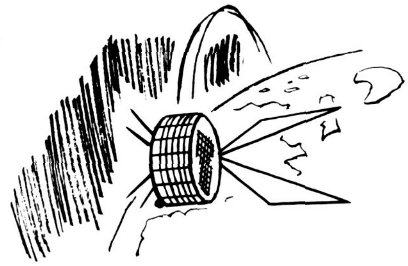
However, the Apollo system is not limited to manned lunar exploration. We can carry out a wide variety of flights in orbit about the earth, about the moon or to the moon's surface. For example, it is possible to place a spacecraft over any point of the Equator so that it can maintain its position above a fixed point on the ground. To do this, we must place the spacecraft in a "synchronous" orbit, a circular orbit at an altitude of 22,000 miles above the Equator.

With an Apollo spacecraft in a synchronous orbit, we could make astronomical observations with a large telescope, and we could use photographic and radar equipment for observations of the earth.

A second class of missions would be to develop the procedures of resupply for a space station and to learn to transfer crew and materials between two spacecraft. Using the same techniques, it would also be possible to make rendezvous with a Pegasus unmanned satellite now in orbit detecting meteoroids. The sensing panels could be returned to earth for analysis.

A third type of mission would place the spacecraft in orbit about the moon for two weeks. Cameras and other sensing equipment could be used to survey the moon's surface for potential landing sites for extended-duration surface missions and for later analysis by land-based geologists.

A fourth kind of mission that could be accomplished would launch a spacecraft to the same place on the moon's surface where a landing has already been made. It thus would be possible to use some



of the equipment left behind on the previous flight and to stay on the moon for several days.

Now the question is why is it desirable to fly such missions? What are the potential applications of benefit to men on earth?

With the weight-lifting capabilities available, it would be possible to place both large antennas and powerful transmitters in stationary orbits. Manned with technicians, these stations are capable of operating over long periods of time. With such equipment, it would be possible to bring live television to all countries of the world and to receive it on ordinary home receivers. With the Syncom satellites now in service we already provide direct communications with the battlefront. With a space station, though, the soldier's walkie-talkie can connect him with command headquarters or with any point in the United States.

An exciting related application is in the early establishment of control towers in space, both for aircraft and for ocean-going ships. From such vantage points it is possible to provide communications and all-weather navigational systems over wide areas now unavailable to earthbound control systems.

An entire group of potential applications is based on the use of observations and actions by human operators in space to make fuller use of the resources of the earth, considered on a planet-wide basis. These resources consist, of course, of the land, the oceans, and the atmosphere.

The use of photography and other forms of remote sensing can supply agriculture with the information it needs on the status of crops and forests on a continental and worldwide basis, so that the techniques of modern analysis can be applied to cope with the needs of an exploding world population.

Remote sensing and photography from space can also fill the need for information on water supplies, the resources that can be extracted from the oceans, and mineral reserves. For example, on his Mercury flight Gordon Cooper photographed a potential oil-bearing area in northern Tibet.

Another application is to the weather. As Mark Twain observed, everyone talks about it and nobody does anything. In January, 1966, a group established by the National Academy of Sciences—a very conservative group, I might add—issued a report indicating that the time may well have come to do something about the weather. In February, 1966, President Johnson recommended to the Congress a long-range program to accomplish weather modification. The Apollo-Saturn flight hardware is capable of assisting in this effort.

Finally, there are the applications to science. At meetings last summer in Woods Hole and Falmouth, Massachusetts, scientists associated with the National Academy of Science and other leaders recommended the exploration of the moon and the placing of large telescopes and other astronomical instruments in space. The reports from these studies expressed the belief that the presence of man in space, close to these instruments, can greatly improve the ability of science to increase knowledge about the origin of life and the history of the earth, the sun, the planets and the universe around us.

Now who are the potential users? There are the users of world communications. There are the airlines. There are the people concerned with world resources, in private life and operating through such agencies as the Department of Agriculture, the U. S. Geological Survey, and the Navy Oceanographic Office. There is the Weather Bureau. There is the

scientific community, with its special interest in astronomy, the exploration of the moon and life sciences in space. Finally, there is the continuing interest of the Department of Defense in new technology and new ways of doing things.

But it is important to emphasize that the first task to be performed, before benefits can be provided to potential users, is to learn to operate effectively and efficiently in space. Before we can deliver people and equipment to the place where this work is to be done, we must investigate the conditions and the problems associated with operations in the weightless, vacuum environment. And we can learn to operate effectively in space only by doing—by spending time in space.

Columbus' voyage to America dramatized the beginning of a great age of exploration even though he went to the wrong place and found a land and a people quite different than he had anticipated. Yet the real contributions which this new continent was to make were certainly well beyond even the wildest imagination of men of that time. It was not until many ships had regularly traveled from Europe to America that, in fact, man really began to explore and exploit this continent.

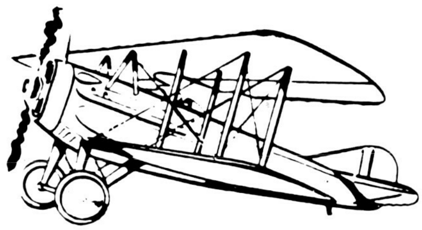
So I think that men will have to live and work in the space environment for some time before they can begin to make full use of this new resource becoming available. The Apollo-Saturn flight equipment will enable us to multiply our present ***man days*** to ***man years*** of flight experience. In the period immediately following the accomplishment of the Apollo program, a most important task will be to gain this experience and to develop advanced operational techniques so necessary for use in future programs.

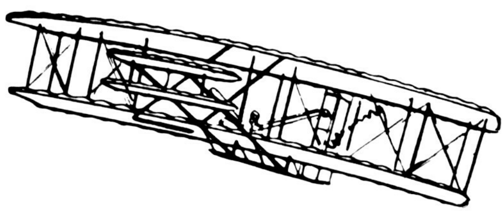
DECISION NEEDED

But there is a problem which is characteristic of government programs. The budget for the coming fiscal year permits NASA to hold open the option for a program to procure additional flight vehicles beyond those now programmed, so as to employ the Apollo hardware and capabilities at least through 1971. If we do not exercise this option in the decisions for the budget for the fiscal year beginning July 1, 1967, we will have to begin a phase down of the manned space flight activities and the "mothballing" of some of our facilities. The option in this budget would also permit us to extend to three months the time the spacecraft could remain in orbit. The time to exercise this option will come in the fall of 1966, when the decisions will be made on the budget to go to Congress for the next fiscal year.

One of the aspects of government budget procedures is their long lead-time nature. We must make our preparations well in advance to permit the Bureau of the Budget to do its work. We are required to submit our preliminary estimates fourteen months before the beginning of the fiscal year.

In summary, therefore, NASA is holding open the option for another year, to employ Apollo flight hardware and capabilities beyond the manned lunar landing, and to extend the capability of the Apollo spacecraft. Missions are available to make use of the equipment for flights in earth orbit, in lunar orbit, and to the moon's surface. Experiments are being defined to determine the value of such missions. Users have expressed interest in the results of such experiments. But first we must develop the ability to operate in space.

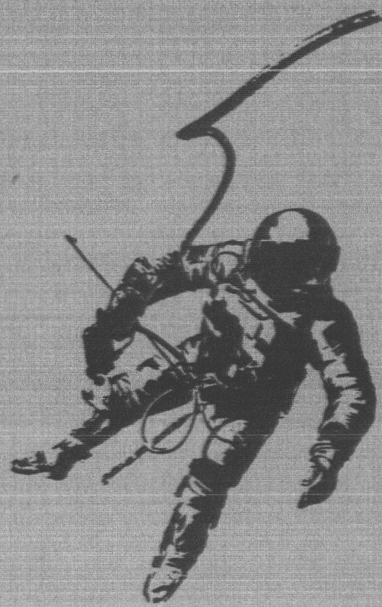




Finally, I would like to call attention to a few facts. The Wright Brothers' first flight at Kitty Hawk dramatized the possibility of flight, but it was not until airplanes were numerous and barnstorming had given way to commercial flight that profit began to come from aeronautics. The history of the airplane is interesting for another reason. Although the United States was first in its invention, it remained for the Europeans to adopt it for practical use, so that this nation was forced to borrow British and French designs for use in World War I and in fact no American-designed plane flew in combat.

The submarine was invented by an American named Holland but first exploited by Germany. Robert Goddard of this country proved that a rocket would work in a vacuum, but the Germans used the principle to build ballistic missiles, and the Soviets first achieved space flight.

I hope that we are perceptive enough to profit from history and that we *do* fully use and exploit these machines we have developed at such a heavy investment of resources, and that we *do* allow ourselves the time and freedom to realize their—and our—full capabilities in space.



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